

## **Marine Biotechnology: Creating New Value from the Sea**

The biotechnology revolution has impacted diverse fields of science and many sectors of the economy. In the environmental arena, application of molecular technologies has brought new ways to identify and mitigate ecological stresses and may hold the keys to remediation. Sales of products developed through biotechnology were up 17 percent in 1998 to \$13 billion—a figure with the potential to reach \$24 billion in 2005. Remarkably, these developments have been largely based upon the molecular genetic characteristics of terrestrial organisms, even though more than 80 percent of all the Earth's phyla are found only in the sea.

Studies that extend biotechnology to the marine environment are few despite numerous, compelling incentives. Marine plants, animals and microorganisms exhibit processes and produce substances unknown in terrestrial organisms. The potential economic and public health benefits of pharmaceuticals, pesticides, hormones, enzymes, and polymers derived from marine organisms are high, yet unexploited. If the United States is to realize the benefits to be derived from marine organisms as sources of new products and processes, and develop viable strategies to conserve them, an increased investment in marine biotechnology is essential.

### **Recent Trends**

- Recent advances in molecular genetics, sensor biology, environmental remediation and bioengineering have greatly expanded the ability to find, manipulate and utilize marine organisms in a sustainable manner.
- Presently, only about 1.2 percent of federal investment in biotechnology research is focused on marine opportunities and problems. In 1992, the U.S. invested \$40 million in marine biotechnology. In contrast, Japan spent \$519 million, recognizing marine biotechnology as the “greatest remaining technology and industrial frontier.”
- Despite limited public funding, investment in marine biotechnology has led to at least 190 U.S. patents. Research in marine biotechnology has yielded at least 30 marine products (targeting cancer, inflammation and AIDS) to reach the stage of preclinical trials. The market value of just five of these has been estimated to be \$2 billion.
- New applications of molecular techniques have given researchers and managers the ability to diagnose emerging diseases and the impacts of pollutants on target organisms as well as ecosystems.

### **Objective**

The objective of this initiative is to accelerate the discovery of new products and technologies from unique marine organisms. The development of novel products from

the sea has the potential to greatly contribute to new treatment for diseases, eliminating drug resistance, providing safe and abundant seafood and in cleaning up the coastal environment. It is expected that this initiative will advance U.S. economic growth, enhance international competitiveness, and promote sustainable development. In support of Administration and DOC programs to achieve these goals, NOAA proposes to develop marine biotechnology to broaden the choices available to the pharmaceutical, agrochemical, and seafood industries, as well as to those concerned with environmental management. Research and technology transfer programs will develop fundamental knowledge of natural products and processes of marine organisms to provide models for new commercial products and new approaches to industrial processing and bioprocessing. Initial emphasis will be on developing products and processes based on deep-sea microbial communities from areas of intense biological activity and extreme conditions.

## Benefits to the Nation

The potential of marine biotechnology to benefit the health of our citizens and the national economy is unlimited. According to a recent report by the NSTC, "Modest investments now in several rapidly developing areas of biotechnology research will lead to major economic and societal benefits ...". Marine natural products, many of which have yet to be discovered, are the key to the development of new types of drugs and products which will allow us to address public health and environmental issues in the next century. For instance, just five drugs developed over the past few years by Sea Grant, with a relatively small investment of funds, have a market potential of almost \$2B annually and address human diseases such as cancer and AIDS, inflammation, new biodegradable agricultural fertilizers, natural antifreeze, and industrial surfactants. Marine biotechnology, already a multibillion dollar industry worldwide, has a projected growth of 15-20% annually over the next 5 years. One marine product alone, the anti-inflammatory agent *Pseudoterosin*, derived from the sea whips (soft corals) found in Florida and elsewhere has yielded royalties in excess of \$1.2 million, and has projected sales of up to \$100 million.

Humankind must adhere to boundaries for harvesting living resources from the sea in order to ensure a resources for future generations. Nonetheless, a large percentage of the nation depends on the sea's living resources for its economic viability. Therefore, we must actively and aggressively seek alternate and additional value from the nation's living marine resources in the form of **new products**, discovered in the sea and then produced through biotechnology or generated through aquaculture. NOAA recognizes that as we enter the 21<sup>st</sup> century, we are moving into an exciting period of opportunity for sustainable development of marine resources. This initiative will focus the talents of the nation's federal and academic research community to develop a suite of new products that will provide **economic value** and benefit the health of US citizens while maintaining the integrity of the marine environment.